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IS 9729 (1981): Methods of measurement of disk record playing equipment [LITD 7: Audio, Video and Multimedia Systems and Equipment]



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“Knowledge is such a treasure which cannot be stolen”

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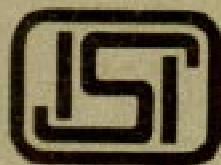
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(Reaffirmed 2001)

Indian Standard

METHODS OF MEASUREMENT ON DISK RECORD PLAYING EQUIPMENT

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METHODS OF MEASUREMENT ON DISK RECORD PLAYING EQUIPMENT

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Indian Standard

METHODS OF MEASUREMENT ON DISK RECORD PLAYING EQUIPMENT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 6 August 1981, after the draft finalized by the Recording Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard deals with the methods of measuring the characteristics of record playing equipment comprising the drive system for the record and the reproducing pick-up system. This standard excludes separate components of such units as well as amplifiers and loudspeakers.

0.3 Performance requirements for disk record playing equipment are covered by the following Indian Standards:

IS : 9272 (Part I)-1979 Disk record playing equipment: Part I
Record player

IS : 9272 (Part II)-1979 Disk record playing equipment: Part II
Amplifiers and loudspeakers

IS : 9551 (Part IV)-1980 High fidelity audio equipment and
systems: Part IV Record playing equipment and cartridges.

0.4 While preparing this standard, assistance has been derived from IEC Pub 98A (1972) 'Method of measurement of the characteristics of disk record playing units' issued by International Electrotechnical Commission.

0.5 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard covers the methods of measuring the characteristics of record playing equipment.

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard the terms and definitions covered in IS : 1885 (Part XLVIII/Sec 1 and Sec 2)-1978* shall apply in addition to the following.

2.1 Reference Signal to Rumble Ratio

If U_o = voltage derived from the reference signal intended for and measured at the same output, and

U = maximum voltage derived from low-frequency vibration within the unit measured at a given output.

Reference signal to rumble ratio = $20 \log \frac{U_o}{U}$ dB

2.1.1 Unweighted Reference Signal to Rumble Ratio — Rumble ratio when U and U_o are measured with a low-pass filter network resulting in the attenuation curve X (see Fig. 1). It is a measure of the very low-frequency rumble which is heard mainly as intermodulation with the wanted recording.

2.1.2 Weighted Reference Signal to Rumble Ratio — Rumble ratio when U and U_o are measured via a weighting network resulting in the attenuation curve Y (see Fig. 1). It is a measure of the rumble which is heard mainly as an independent signal.

2.1.3 Reference Signal to Rumble Ratio Spectral Distribution — Ratio of rumble components plotted as a function of frequency when U and U_o are measured via the one-third octave filters listed in A-2. It is an analytical measure of rumble to be interpreted depending on the application.

2.2 Reference Signal to Hum Ratio

If U_o = voltage derived from the reference signal intended for and measured at the same output

U = maximum voltage at a given output derived from stray fields when the reproducing stylus tip is 2.5 mm above the rotating turntable; and at a distance between 50 and 150 mm from the centre of rotation of the turntable.

Reference signal to maximum hum ratio = $20 \log \frac{U_o}{U}$ dB

2.3 Signal Characteristic — The relative output levels (in decibels) as a function of frequency of any given channel activated by signals intended for that channel, when the relative signal recording and reproducing levels are in accordance with IS : 9305-1979† and IS : 9272 (Part II)-1979‡.

*Electrotechnical vocabulary: Part XLVIII Recording, Sec 1 Tape recording and Sec 2 Disk recording [superseding IS : 1885 (Part III/Sec 3)-1967].

†Specification for processed disk records.

‡Specification for disk record playing equipment.

2.4 Separation Response (for Stereo Use Only) — The relative output levels (in decibels) as a function of frequency of any given channel activated by signals intended for the opposite channel, when the relative signals (recording and reproducing) levels are in accordance with IS : 9305-1979* and IS : 9272 (Part II)-1979†.

3. OBJECT

3.1 The object of this standard is to list and define the most important parameters affecting the quality of performance of record playing units, and to establish agreed methods of measurement of these parameters.

4. GENERAL CONDITIONS OF MEASUREMENT

4.0 Unless otherwise specified, the measurements shall be made under the measuring conditions specified below.

4.1 Normal Supply Voltage — The rated supply voltage shall be applied to the equipment.

4.1.1 The voltage applied to the equipment shall be held constant within 1.0 percent of the rated value during the measurement of the characteristics.

4.1.2 In case of ac mains operations, the voltage applied shall be 240V at 50 Hz frequency, unless otherwise specified. The harmonic content of ac mains supply-voltage shall not exceed 5.0 percent.

4.1.3 In case of battery operation primary batteries of the type and rated voltage as specified by the manufacturer shall be used.

4.2 Atmospheric Conditions for Testing

4.2.1 Unless otherwise specified all measurements shall be carried under the following atmospheric conditions:

Temperature : 15° to 35°C

Relative humidity : 45 to 75 percent

Air pressure : 86 to 106 kPa (1 kPa = 10 m bar)

4.2.2 Referee Conditions — In cases where the characteristics are sensitive to ambient conditions, the following referee conditions shall be maintained during the measurements :

Temperature : $27^{\circ} \pm 1^{\circ}\text{C}$

Relative humidity : 65 ± 2 percent

Air pressure : 86 to 106 kPa (1 kPa = 10 m bar)

*Specification for processed disk records.

†Specification for disk record playing equipment.

4.3 Operating Conditions

4.3.1 Before any measurements are taken, the unit shall operate for at least the stabilization time specified by the manufacturer or 10 minutes whichever is greater.

4.3.2 Before any measurements are taken, all measuring equipment shall have reached temperature stability.

4.3.3 The sensitivity of measuring equipment shall be independent of frequency, and the output of the unit shall be taken from the correction or equalization network (if any). Where the unit has both a correction and an equalization network, the output shall be taken from the equalization network.

4.3.4 Apart from specified load, the measuring equipment shall not introduce an additional load which would significantly affect the parameters to be measured.

4.4 Test Records — Test record used for any measurement, shall be identified by catalogue number, names of manufacturer and country of manufacture.

NOTE — In order to achieve comparable results, test records for a particular purpose should be derived from the same original recording. However, even given this condition, variations in record manufacture such as record material pressing conditions, etc, may give rise to variations in parameters such as high-frequency response, separation, wow, flutter and rumble.

4.5 Accuracy of Test Set-up — The test set-up employed to carry out measurements in accordance with this standard shall have an accuracy of at least one order better than that specified for the quantity under measurement.

4.6 Rated Speed — The rated disc record speeds shall be as follows:
78, 45 and 33 1/3 rev/min

4.7 Test Frequencies — For measurements to be made at a number of frequencies, the frequencies shall be selected from IS: 2264-1963* in addition to 12.5 Hz.

4.8 Reporting — The test report shall clearly indicate the following:

- a) Supply voltage (ac or dc) and frequency in the case of ac,
- b) Atmospheric conditions under which tests are carried out,
- c) Any change or necessary adjustments to the equipment done before measurement, and
- d) Results of tests.

*Preferred frequencies for acoustical measurements.

5. METHODS OF MEASUREMENT

5.1 Input Rating of Motor

5.1.1 The current (I amp) taken from the supply source shall be measured by means of an ammeter to an accuracy of ± 3 percent when the motor is operating under maximum voltage and load conditions.

5.1.2 The input rating of motor given as (I $\times$ maximum rated voltage) VA.

NOTE — The above measurements may also be made at rated voltage and maximum load conditions.

5.2 Speed of Rotation

5.2.1 Mean Deviation from Rated Speed

5.2.1.1 Method 1 — A strobedisk rotating with a record being played is illuminated by a discharge lamp operated at rated power supply frequency (f) of 50 Hz. Viewing the record from above, the number of apparent bars passing a fixed point per second (N) is counted, clockwise movement being regarded as positive ($+N$) and anticlockwise movement as negative ($-N$).

<i>Rated Speed</i>	<i>Number of Bars on Strobedisk</i>
rev/min	
77.92	77
45.11	133
33.33	180

5.2.1.2 The mean deviation from rated speed is given as:

$$\frac{N}{2f} \times 100, \text{ percent}$$

5.2.1.3 Method 2 — While the record is being played, 100 revolutions of a record are timed by means of a suitable timing device (t : s)

<i>Rated Speed</i>	<i>Time for 100 Revolutions, T_s</i>
rev/min	
77.92	77
45.11	133
33.33	180

The mean deviation from rated speed is given as $\frac{T-t}{t} \times 100$ percent

5.3 Wow and Flutter

5.3.1 Speed fluctuations shall be measured in accordance with IS : 8152-1976*.

5.3.2 For this purpose a test record (*see A-1*) containing a lateral signal of 3 150 Hz, centred with respect to the rotational axis of the unit by means of a concentric groove situated near the edge of the record, shall be used. The 3 150 Hz band shall be played and the output fed to a measuring instrument through a weighting filter resulting in the attenuation curve referred to in IS : 8152-1976†.

5.3.3 Units without a speed regulator shall be measured at the actual speed; those with regulator shall be measured at the rated speed.

5.3.4 Arithmetic means of at least three meter readings shall be taken for weighted wow and flutter.

5.4 Reference Signal to Rumble Ratio

5.4.1 Method A

5.4.1.1 This method is intended for general use where a simple result is required.

5.4.1.2 A test record (*see A-2*) containing an unmodulated section of the groove as well as reference signals intended for the left, right, lateral and vertical measuring planes is played. By means of VU meter { which shall be as specified in IS : 9302 (Part IX)-1980 }‡ the maximum output voltage derived from the unmodulated groove is compared with the output voltage derived from the reference signal corresponding to the plane of measurement, both readings being taken through a network resulting in the following attenuation curves (*see Fig. 1*):

- a) X indicates unweighted rumble ratio;
- b) Y indicates weighted rumble ratio.

NOTE 1 — For stereo use, unweighted and weighted rumble ratios are determined for left, right, lateral and vertical planes.

NOTE 2 — For mono use, unweighted and weighted rumble ratio are determined for the lateral plane.

*Method of measurement of speed fluctuation in sound recording and reproducing equipment.

†Method of measurement of speed fluctuations in sound recording and reproducing equipment.

‡Characteristics and methods of measurement in sound system equipment; Part IX Programme level meters.

5.4.1.3 The results are given as:

- a) For stereo use :
 - i) Unweighted reference signal = the smallest of left, right, lateral and vertical unweighted rumble ratios
 - ii) Weighted reference signal = the smallest of left, right, lateral and vertical weighted rumble ratios
- b) For mono use :
 - i) Unweighted reference signal = lateral unweighted rumble ratio
 - ii) Weighted reference signal = lateral weighted rumble ratio

5.4.2 Method B

5.4.2.1 This method is applicable for specialists use, when an analytical result is required.

5.4.2.2 A test record (see A-2) containing an unmodulated section of groove as well as reference signals intended for the left, right, lateral and vertical measuring planes is played. By means of a VU meter [which shall be as specified in IS : 9302 (Part IX)-1980*] the voltage U_0 produced by the reference signal is measured at the output terminals of the one-third octave filter whose mid-frequency corresponds to the frequency of the reference signal. A search is thus made over the frequency range between 12.5 Hz and 315 Hz at 1/3 octave frequencies (see IS : 2264-1963†) and for each of the bands concerned, the voltage U at the output terminals of the one-third octave filters listed above are measured and the ratios $20 \log \frac{U}{U_0}$ determined.

5.4.2.3 For stereo use the rumble ratios are determined for left, right, lateral and vertical planes for each frequency band.

5.4.2.4 For mono use, the rumble ratio is determined for the lateral plane for each frequency band.

5.4.2.5 For stereo use, the rumble spectrum distribution is obtained by plotting left, right, lateral and vertical rumble ratios as a function of frequency in accordance with IS : 8159-1976‡.

5.4.2.6 For mono use rumble spectrum distribution is obtained by plotting the lateral rumble ratio as a function of frequency in accordance with IS : 8159-1976‡.

*Characteristic and methods of measurement of sound system equipment : Part IX Programme level meters.

†Preferred frequencies for acoustical measurements.

‡Scales and sizes for plotting frequency characteristics and polar diagram.

5.5 Reference Signal to Hum Ratio

5.5.1 A test record (*see* A-2) containing reference signals intended for the left, right, lateral and vertical measuring planes is played and the voltage is measured from the respective outputs U_{OA} , U_{OB} , U_{OM} , and U_{OS} .

5.5.2 The reproducing stylus is then placed 2.5 mm above the surface of the rotating turntable and in a radial position between 50 and 150 mm to give maximum voltage for each output.

$$U_A, U_B, U_M, U_S.$$

5.5.3 Four hum ratios are obtained as follows:

- a) Left hum ratio $= 20 \log \frac{U_{OA}}{U_A} \text{dB}$
- b) Right hum ratio $= 20 \log \frac{U_{OB}}{U_B} \text{dB}$
- c) Lateral hum ratio $= 20 \log \frac{U_{OM}}{U_M} \text{dB}; \text{ and}$
- d) Vertical hum ratio $= 20 \log \frac{U_{OS}}{U_S} \text{dB}$

5.5.4 The results are given as :

- a) For stereo use reference signal to hum ratio = the smallest of left, right, lateral and vertical hum ratios.
- b) For mono use, reference signal to hum ratio = the lateral hum ratio.

5.6 Channel Sensitivity at 1 000 Hz

5.6.1 A test record (*see* A-3) containing left, right, lateral and vertical reference signals, of 1 000 Hz recorded at a velocity v cm/s, is played and the voltage $U_m V$ is measured from the respective outputs.

5.6.2 If U_A , U_B , U_M , U_S denote left, right, lateral and vertical output voltages respectively, the results are given as:

- a) For stereo use channel sensitivity $= \frac{U_A + U_B}{2v} \text{ mV per cm/s}$
- b) For mono use channel sensitivity $= \frac{U_M}{v} \text{ mV per cm/s,}$

5.7 Channel unbalance at 1 000 Hz (for stereo use only).

5.7.1 The left and right output voltages are determined as in 5.6.

5.7.2 The channel unbalance at 1 000 Hz is given as $\left(20 \log \frac{U_B}{U_A} \right) \text{dB}$.

5.8 Minimum Separation at 1 000 Hz (Stereo Use Only)

5.8.1 Two signals (X_A and X_B) of identical recorded velocity and of frequency 1 000 Hz intended for left and right outputs respectively shall be used for the test.

5.8.2 The voltage is measured from the left output when activated by X_B and X_A .

5.8.3 The voltage is measured from the right output when activated by X_A and X_B .

5.8.4 The minimum separation at 1 000 Hz is calculated as:

a) Separation on channel B = $20 \log \frac{\text{output voltage at B due to } X_B}{\text{output voltage at B due to } X_A} \text{ dB}$

b) Separation on right channel A

$$= 20 \log \frac{\text{output voltage at A due to } X_A}{\text{output voltage at A due to } X_B} \text{ dB}$$

5.9 Frequency Characteristic

5.9.1 Signal Characteristic

5.9.1.1 A test record (see A-3) is played, which carries either fixed or swept frequencies intended for the channel to be measured. The variations of output level (in decibels) as a function of frequency are plotted on a graph in accordance with IS : 8159-1976*.

5.9.1.2 The results are given in a graph form for the following:

- a) For stereo use, the signal characteristic of each stereo channel; and
- b) For mono use, the lateral signal characteristic.

5.9.2 Separation Response (for Stereo Use Only)

5.9.2.1 A test record (see A-3) is played, which carries either fixed or swept frequencies intended for the channel opposite to that which is to be measured. The variations of output level (in decibels) as a function of frequency are plotted on a graph in accordance with IS : 8159-1976*.

*Scales and sizes for plotting frequency characteristics and polar diagrams.

5.9.2.2 The resulting separation response of each channel is quoted in graph form, preferably on the same graph as the signal response.

5.10 Tracking Ability

5.10.1 A test record (*see A-4*) is played, and the output voltage is monitored by means of a loudspeaker and/or an oscilloscope.

5.10.2 Poor tracking is indicated by a buzz-like audible distortion from the loudspeaker and by a clearly visible discontinuity in the waveform on the oscilloscope.

5.10.3 The minimum tracking force is determined which achieves a buzz-free sound and/or a continuous waveform throughout the frequency sweeps on both sides of the test record.

6. INFORMATION TO BE SUPPLIED BY THE MANUFACTURER OF RECORD PLAYING UNIT

6.1 The relevant information as specified in Appendix B should be supplied by manufacturers claiming characteristics measured in accordance with this standard together with any additional details which may be pertinent to a correct interpretation of the results.

A P P E N D I X A

(*Clauses 2.1.1, 2.1.2, 2.1.3, 5.3.2, 5.4.1.2, 5.4.2.2, 5.5.1, 5.6.1, 5.9.1.1, 5.9.2.1 and 5.10.1*)

TEST RECORDS

A-1. TEST RECORDS FOR MEASUREMENT OF WOW AND FLUTTER

A-1.1 The dimensions shall comply with Type III record of nominal diameter 300 mm, speed $33\frac{1}{3}$ rev/min or Type VI record of nominal diameter 175 mm, speed 45 rev/min (*see 3* of IS : 9305-1979*).

A-1.2 The lead-in groove shall be replaced by a concentric groove of diameter 294 mm or 170 mm respectively, and serves for centering the record with respect to the axis of rotation.

A-1.3 The recording consists of a lateral signal of 3 150 Hz cut over the entire record. The weighted wow and flutter of the recording as measured with the wow and flutter meter conforming to IS : 8152-1976† shall be less

*Specification for processed disk records.

†Methods of measurement of speed fluctuations on sound recording and reproducing equipment.

than ± 0.06 percent. Vertical movement of the record edge shall be less than 0.3 mm.

A-1.4 Examples of test records shall be as follows:

<i>Catalogue Number</i>	<i>Country of Origin</i>	<i>Name of Manufacturer</i>	<i>Speed of Rotation rev/min</i>
DIN 45545	Germany	D.G.G.	33 $\frac{1}{3}$

A-2. TEST RECORD FOR MEASUREMENT OF RUMBLE LEVEL

A-2.1 The dimensions shall comply with Type III record of diameter 300 mm, speed $33\frac{1}{3}$ rev/min (see 3 of IS : 9305-1979*).

A-2.2 The reference levels shall be as follows:

<i>Modulation Mode</i>	<i>Recorded Velocity</i>				<i>Diameter</i>	
	Frequency Hz	R M S cm/s	Peak cm/s	Duration s	Start mm	Finish mm
Left	315	3.83	5.42	15	290	286
Right	315	3.83	5.42	15	284	280
Lateral	315	3.83	5.42	15	278	274
Vertical	315	3.83	5.42	15	272	268
Unmodulated	—	—	—	†	266	112

NOTE — The reference frequency of 315 Hz was chosen in order to coincide with the maximum of the weighting filter curve (weighted rumble ratio) and to lie on the straight line portion of the low-pass filter curve (unweighted rumble ratio). Assuming a reference recorded velocity of 7 cm/s, r m s (10 cm/s peak) at 1 000 Hz on stereo (left or right), the recording characteristic, as specified in IS : 9305-1979* gives an equivalent recorded velocity of 3.83 cm/s, r m s (5.42 cm/s peak) at 315 Hz. In a similar manner, reference frequencies other than 315 Hz may be chosen. With a groove spacing of 0.18 mm/turn, the reproducing stylus will traverse the record at 0.1 mm/s. Thus the chart from a level recorder operating at a paper speed of 0.1 mm/s may be placed on the record to indicate rumble level as a function of the radial position of the reproducing stylus.

A-2.3 Attenuation Curve

A-2.4 Examples of Test Records

<i>Catalogue Number</i>	<i>Country of Origin</i>	<i>Name of Manufacturer</i>	<i>Speed of Rotation, rev/min</i>
DIN 45544	Germany	Lindstrom	$33\frac{1}{3}$

*Specification for processed disk records.

†The spacing of the unmodulated grooves shall be 0.18 mm/turn.

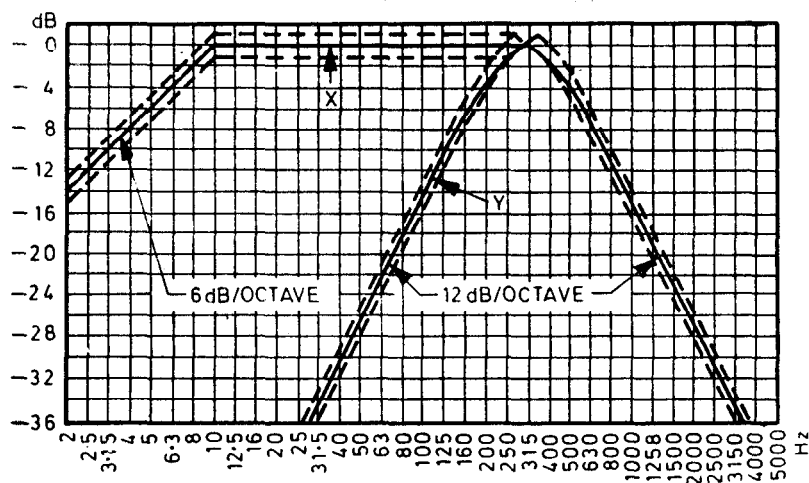


FIG. 1 ATTENUATION CURVE

A-3. EXAMPLES OF TEST RECORDS RECOMMENDED FOR CHANNEL SENSITIVITY, CHANNEL UNBALANCE, MINIMUM SEPARATION AND FREQUENCY CHARACTERISTIC

Catalogue Number	Country of Origin	Name of Manufacturer	Modulation	Speed of Rotation rev/min
STR 100	USA	CBS	Left, right	33 $\frac{1}{3}$
TCS 101	UK	EMI	Left, right	33 $\frac{1}{3}$
TCS 104	UK	EMI	Lateral	33 $\frac{1}{3}$
TCS 105	UK	EMI	Vertical	33 $\frac{1}{3}$
SXL 2057	UK	Decca	Left, right	33 $\frac{1}{3}$
LXT 5346	UK	Decca	Lateral	33 $\frac{1}{3}$
DIN 45541	Germany	D.G.G.	Left, right, lateral	33 $\frac{1}{3}$
QR 2009	Denmark	B & K	Left, right, lateral, vertical	45
STR 120	USA	CBS	Left, right, lateral, vertical	33 $\frac{1}{3}$
STR 130	USA	CBS	Left, right, lateral	33 $\frac{1}{3}$
TCS 101 } frequency	India	The Gramophone Co of India Ltd, Calcutta	Left, right, lateral	33 $\frac{1}{3}$
TCS 104 } record				33 $\frac{1}{3}$

NOTE — In 5.9, it is assumed that test records are recorded in accordance with the recording characteristics as specified. If this is not the case, it is essential that the necessary correction be applied.

A-4. TEST RECORD FOR MEASUREMENT OF TRACKING ABILITY

A-4.1 The dimensions comply with Type V record of nominal diameter 175 mm, speed $33\frac{1}{3}$ rev/min (see 3 of IS : 9305-1979*). The recording consists of a reference signal of 2 000 Hz recorded at 1 cm/s, r.m.s starting at a diameter of 167 mm and lasting for 40 s. It is followed by a frequency sweep from 80 to 8 000 Hz and then to 80 Hz, starting at a diameter of 153 mm and lasting for 90 s. The recorded levels of the frequency sweep are shown in Fig. 2 and approximate to the average recorded levels found on disk records. The vertical tracking angle is $+15^\circ$. One side of the test record is modulated normal to the inner groove wall (left channel) and the other side is modulated normal to the outer groove wall (right channel).

A-4.2 The test record is manufactured in the United Kingdom by EMI Ltd under the catalogue number TS 201.

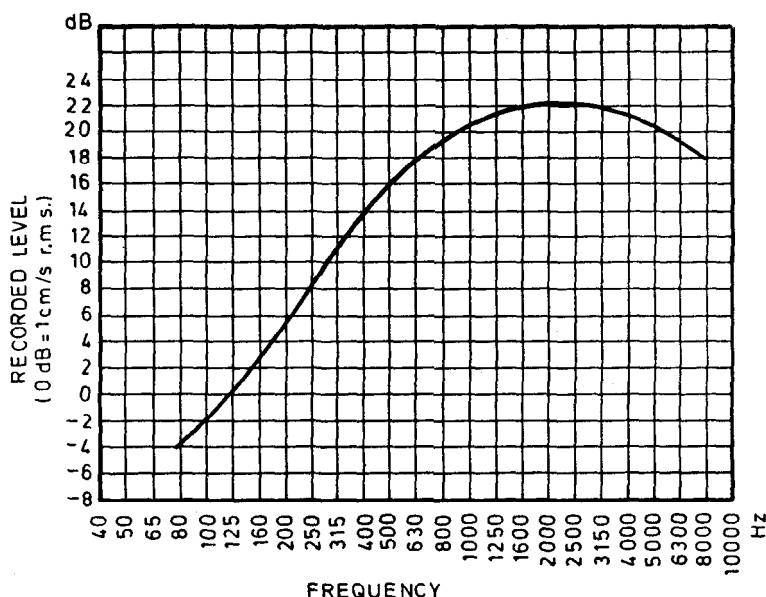


FIG. 2 RECORDED LEVELS OF FREQUENCY SWEEP

*Specification for processed disk record.

APPENDIX B

(Clause 6.1)

INFORMATION TO BE SUPPLIED BY THE MANUFACTURER OF RECORD PLAYING UNIT

B-1. IDENTIFICATION

B-1.1 Name of Manufacturer

B-1.2 Country of Manufacturer

B-1.3 Model or Type Number (Variants, if any, to be Stated)

B-2. STRUCTURE

B-2.1 Pickup System

- | | |
|--------------------------------|----------------------|
| a) Type of transducer | for example, ceramic |
| b) Type of reproduction | for example, stereo |
| c) Reproducing stylus material | for example, diamond |
| d) Stylus changeable | Yes/No |
| e) Pickup system changeable | Yes/No |

B-2.2 Drive System

- | | |
|------------------------------------|-------------------------------------|
| a) Type of motor | for example, synchronous |
| b) Speeds of rotation of turntable | for example, 33 1/3 rev/min |
| c) Speed regulator | Yes/No |
| d) Speed indicator | for example, stroboscope:
Yes/No |

B-2.3 Space Requirements

- | | | |
|--|------------|----|
| a) Minimum length of mounting board | } template | |
| b) Minimum width of mounting board | | |
| c) Minimum clearance below top of mounting board | | mm |
| d) Minimum clearance above top of mounting board | | mm |

B-2.4 Operational Modes

- | | |
|---|--------|
| a) Aid to manual pickup lowering | Yes/No |
| b) Aid to manual pickup lifting | Yes/No |
| c) Cueing device for programme location | Yes/No |

d) Automatic pickup lowering	Yes/No
e) Automatic pickup lifting	Yes/No
f) Automatic pickup return	Yes/No
g) Automatic motor stop	Yes/No
h) Suitable for playing records of diameter(s)	for example, 300 mm
j) Automatic record change	Yes/No
1) Automatic size selection	Yes/No
2) Maximum stack height of records or maximum number of records of effective thickness 2.3 mm	mm for example, 8

B-3. RECOMMENDED OPERATING CONDITIONS

The rated value of the parameter shall be stated first, followed by the tolerance quoted in the same units (for example, 240 ± 10 V).

B-3.1 Environment

a) Ambient temperature	°C
b) Relative humidity	percent
c) Air pressure	mbar
d) Stabilization time of unit from ambient temperature	min

B-3.2 Electric Power Supply

a) Type of supply	ac and/or dc
b) Voltage(s)	V
c) Frequency (ies)	Hz

B-3.3 Pickup Operation

a) Stylus tip dimensions	
1) Frontal radius	μm
2) Fore/aft radius	μm
b) Tracking force	mN
c) Load impedance per channel	resistance in k, capacitance in pF
d) Correction network (if any)	diagram

NOTE — The correction network is in addition to the equalization network required.

B-4. PERFORMANCE CLAIMS

The performance claims shall relate to the unit when operating under the recommended operating conditions for testing (*see B-3*). The least favourable figure is quoted.

B-4.1 Input Rating of Motor —

VA

B-4.2 Speed of Rotation

- a) For units without speed regulator:
 - 1) Mean deviation from each rated speed percent
 - 2) Weighted wow and flutter at each actual speed percent
- b) For units with speed regulator:
 - 1) Range of adjustment from each rated speed percent
 - 2) Weighted wow and flutter at each rated speed percent

B-4.3 Reference Signal to Rumble Ratio

- a) Unweighted reference signal to rumble ratio dB
- b) Weighted reference signal to rumble ratio dB
- c) Reference signal to rumble ratio spectral (distribution) Graph

B-4.4 Reference Signal to Hum Ratio —

dB

B-4.5 Channel Sensitivity at 1 000 Hz — The rated value shall be stated first, followed by the tolerance quoted in the same units.

- a) *For stereo use:*
 - Arithmetic mean of left and right channels mV per cm/s
- b) *For mono use:*
 - Lateral channels mV per cm/s

B-4.6 Channel Unbalance at 1 000 Hz (Stereo Use Only) — dB**B-4.7 Minimum Separation at 1 000 Hz (Stereo Use Only) — dB****B-4.8 Frequency Response**

- a) Signal response Graph
- b) Separation response (stereo use only) Graph

B-4.9 Tracking Ability (Minimum Tracking Force) mN

INDIAN STANDARDS

ON

RECORDING

IS:

- 1885 (Part XLVIII/Sec 1)-1978 Electrotechnical vocabulary: Part XLVIII Recording, Section 1 Tape recording [*superseding* IS : 1885 (Part III/Sec 3)-1967]
- 1885 (Part XLVIII/Sec 2)-1978 Electrotechnical vocabulary: Part XLVIII Recording, Section 2 Disk recording [*superseding* IS : 1885 (Part III/Sec 3)-1967]
- 2032 (Part XII)-1969 Graphical symbols used in electrotechnology: Part XII Electro-acoustic transducers and recording and reproducing systems
- 3956-1967 Dimensions of spools for magnetic tapes for sound recording and reproduction
- 4377-1967 General requirements for magnetic tapes for sound recording and reproduction
- 4379-1967 Methods of measurement on magnetic tapes for sound recording and reproduction
- 4480 (Part I)-1967 Magnetic tapes for sound recording and reproduction: Part I Domestic grade
- 4480 (Part II)-1974 Magnetic tapes for sound recording and reproduction: Part II Professional grade
- 6370-1971 Tape cassettes for domestic use
- 6391-1971 Magnetic and ceramic phonograph pick-ups
- 7068-1973 Specification for 6.25 mm calibration tape
- 7594 (Part I)-1978 Magnetic sound tape recording and reproducing equipment (cassette): Part I Methods of measurement
- 7594 (Part II)-1979 Magnetic sound tape recording and reproducing equipment (cassette): Part II Domestic type
- 8152-1976 Method of measurement of speed fluctuations in sound recording and reproducing equipment
- 8234-1976 Spools for magnetic tapes for sound recording and reproduction
- 8655 (Part I)-1977 Magnetic sound tape recording and reproducing equipment (reel-to-reel): Part I Methods of measurement
- 8655 (Part III)-1977 Magnetic sound tape recording and reproducing equipment (reel-to-reel): Part III Professional type
- 9272 (Part I)-1979 Disk record playing equipment: Part I Record player
- 9272 (Part II)-1979 Disk record playing equipment: Part II Amplifiers and loud-speakers
- 9305-1979 Processed disk records
- 9551 (Part IV)-1980 High fidelity audio equipment and systems : Part IV Record playing equipment and cartridges
- 9551 (Part V)-1980 High fidelity audio equipment and systems: Part V Magnetic sound tape recording and reproducing equipment

INTERNATIONAL SYSTEM OF UNITS SI (UNITS)

Base Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous Intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>	<i>Definition</i>
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²